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Original Article

Antioxidant and SPF Activity of Sunscreen Cream Preparations from 96% Ethanol Extract of Bractea *Bougainvillea spectabilis* Willd.

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Abstract

Bractea *Bougainvillea spectabilis Willd* contains antioxidants which are used to brighten and moisturize the skin. Antioxidants can delay and prevent free radicals in the skin. The aim of this research is to make sunscreen cream preparations from 96% ethanol extract of Bougainvillea spectabilis Willd bractea ethanol extract with good physical quality, determine antioxidant activity and value. *Sun Protection Factor (SPF)* and testing the stability of sunscreen cream preparations. Testing antioxidant activity uses the DPPH Free Radical Reduction method, while determining the SPF value using *in vitro* using a UV-Vis spectrophotometer. The results of the research show that 96% ethanol extract of Bougainvillea spectabilis Willd bractea ethanol extract can be made into a cream that has good physical quality. Antioxidant activity of 1.5% ethanol extract (F3) bractea cream *Bougainvillea spectabilis* Willd with IC value$_{50}$ amounting to 10.48 ± 3.92 (very strong category) has higher antioxidants compared to 0.5% ethanol extract cream (F1) has IC_{50} 26,62 ± 6,73 (very strong category) and 1,0% ethanol extract cream (F2) has IC_{50} 26.15 ± 3.22 (very strong category), compared to the positive control lower vitamin C cream 0.5% has IC_{50} 6.95 ± 0.51 (very strong category). Sunscreen activity of 96% ethanol extract *Bougainvillea spectabilis* Willd Formula F3 has an SPF value of 21.22 ± 1.58 (ultra protection category) and has higher sunscreen activity than F1 with an SPF value of 12.48 ± 0.05 (minimal protection category) and F2 with an SPF value of 16.69 ± 0. 21 (ultra protection category) and positive control PABA2% cream SPF value 6.95 ± 0.51 (extra protection category).

Keywords: *Antioxidant, Bractea Bougainvillea spectabilis Willd., Cream, SPF*

Introduction

Sunlight, as a natural light source, has a very important role for the survival of all living creatures. Apart from providing benefits, sunlight can also have detrimental effects on the skin, especially if the amount of exposure is excessive. Excessive sun exposure will have effects such as darker skin color, erythema, sunburn, skin shrinking, premature aging, and skin cancer. UV-A (320–360 nm), UV-B (280–320 nm), and UV-C (100–280 nm) are the three types of ultraviolet (UV) light that pose a threat from sunlight. UV-B rays are more damaging to the skin because they can cause sunburn and skin cancer.

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Naturally, humans have protection against UV rays by producing sweat, thickening the stratum corneum and forming melanin in the epidermis. However, prolonged exposure to UV rays causes this natural system to not function properly, causing detrimental effects on the skin. Therefore, we need sunscreen compounds to shield the skin from direct UV radiation.

Traditionally, *Bougainvillea spectabilis* Willd. bractea ethanol extract is used to brighten and moisturize facial skin. So far, the ethanol extract of *Bougainvillea spectabilis* Willd. bractea has only become organic waste. *Bougainvillea spectabilis* Willd Bractea ethanol extract contains active compounds, namely flavonoids, saponins, and alkaloids, and contains carbohydrates, fats, proteins, and calcium, which can maintain the essential oils it contains. Antioxidant activity of methanol extract in flowers *B. buttiana, nilai* IC_{50} 223, 10 ppm. The flower extract of B. glabra has the highest SPF value at a concentration of 1.5% of 16.96 (medium category) (Aji & Adiwijaya, 2020). Ethanol extract cream preparation from Bractea B. glabra has antioxidant activity with an IC_{50} value of 2.27 ppm (Simatupang *et al.*, 2021).

Compounds that have a large role in the SPF value of the bractea *Bougainvillea spectabilis* Willd, namely flavonoid and alkaloid compounds (Yuliani *et al*., 2024). Previous research has not produced a sunscreen dosage form from a 96% ethanol extract of Bractea *Bougainvillea spectabilis* Willd. So, in this research, ethanol extract from Bractea *Bougainvillea spectabilis* Willd is formulated in the form of sunscreen cream cosmetic preparations.

Antioxidants can delay or prevent free radical oxidation reactions, thereby reducing oxidative damage that will affect facial skin health, including acne appearance. Free radicals are molecules that have a group of atoms with unpaired electrons (Varesi *et al.,* 2022). Damage to cell components causes premature skin aging, characterized by dry, wrinkled, and dull skin. Therefore, a cosmetic preparation is necessary to prevent premature aging (Yusharyahya, 2021).

The spectrum of sunlight that plays a role in dermatoheliosis is ultraviolet (UV) light. UV radiation causes free radicals in the skin. These free radicals block the diffusion of nutrients, inactivate enzymes, oxidize fats, and break down DNA so that they can help the emergence of precancerous conditions. We use topical administration of antioxidants to shield the skin from oxidation-induced damage and halt premature aging (Varesi *et al*., 2022). We chose the cream dosage form because it spreads evenly on the skin, absorbs easily, and dries quickly. As a result, it avoids a sticky effect by not leaving an oily impression on the skin. In this research, we tested the antioxidant activity and physical stability of the extract cream using the ethanol extract from Bractea *Bougainvillea spectabilis*.

Material and Methods

Material

The materials are used in this research are bractea of *Bougainvillea spectabilis* Willd, stearic acid, acetyl alcohol, triethanolamine, glycerin, methyl paraben, propyl paraben, ammonia, chloroform, Dragendorff's reagent, Mayer's reagent, Bouchardat's reagent, $AlCl_3$ 10%, NaOH 1N, concentrated hydrochloric acid, $FeCl_3$, ether, H_2SO_4 concentrated, 96% alcohol, distilled water, 1,1- diphenyl-2-picrylhydrazyl (DPPH), vitamin C, and methanol.

Tool

The tools used in this research were a UV-Vis Spectrophotometer (Shimadzu UV1700V), *rotary evaporator* (IKA RV 10 basic), digital scale (Acis), pH meter (ATC), blender (Miyako), sieve no. 40 mesh, oven, viscometer (*Brookfield* MLVT115), filter paper and glassware.

Sample Preparation Method

Collection Bractea *Bougainvillea spectabilis* Willd. is from the Penfui area, Kupang city, East Nusa Tenggara. Collect Bractea *Bougainvillea spectabilis* Willd. up to 4 kg, wash it thoroughly, drain it, and

then cut it into small pieces. We then dried it in the oven at 70 °C for 2 days. We blended and sieved the samples using a 40-size sieve mesh, resulting in a fine dry powder weighing 960 grams.

Preparation of 96% Ethanol Extract Bractea Bougainvillea spectabilis leaves Willd

We macerated a dry powder of 958 g of *Bougainvillea spectabilis* Willd. bractea ethanol extract with 2.5 liters of 96% ethanol solvent for 24 hours, then filtered and soaked in 96% ethanol twice more. Maserate is thickened with a rotary evaporator at a temperature of 50 °C.

The thick extract obtained was then calculated for the percent yield using the:

$$\text{yield} = \frac{EXTRACT\ WEIGHT}{POWDER\ WEIGHT} \times 100\% \quad (2)$$

Phytochemical Test (Harborne, 1987)

a. Alkaloid Test

The study involved a total of 2 g of thick extract of Bractea *Bougainvillea spectabilis*. The sample was dissolved in 10 ml of chloroform, to which 10 drops of NH_4OH were added. The mixture was then filtered into a test tube, mixed with H_2SO_4, shaken for 1 minute, and allowed to form for 10 seconds. The formation of a stable foam, measuring 1 cm high and lasting for no less than 10 minutes, indicates positive results.

b. Tanin Test

A total of 0.5 g of sample was dissolved in water until it was colorless. Then take 2 mL and add 1-2 drops of FeCl reagent. Positive test results are indicated by the appearance of a green, blue or black color.

c. Steroid and Triterpenoid Test

A total of 2 g of thick extract each was added with 20 mL of ether and left for 2 hours (in a tightly closed container) then filtered and the filtrate taken. A total of 5 mL of the filtrate was evaporated in an evaporator cup until a residue was obtained. The residue was added with 2 drops of acetic anhydride and 2 mL of chloroform, then concentrated sulfuric acid was added through the tube wall. If a red color forms, it indicates the presence of triterpenoids, whereas if a green color forms, it indicates the presence of steroid compounds.

d. Flavonoid Test

As much as 0.5 g of thick ethanol extract bractea *Bougainvillea spectabilis* Willd. was dissolved in 5 mL of 95% ethanol. 2 mL of the extract solution was taken, and 0.1 g of concentrated hydrochloric acid was added, shaken gently. The presence of flavonoids was confirmed with the formation of a red orange to purple-red color.

e. Quinone assay

A total of 5 ml of the experimental solution was obtained from the identification of flavonoids, put into a test tube, add a few drops of 1 N NaOH solution. The formation of a red color indicates the presence of quinone group compounds.

f. Saponin Test

A total of 0.5 g of extract plus 5 mL of distilled water. Then heated for 5 minutes, the foam formed was approximately 1 cm high and remained stable after leaving it for 10 minutes indicating the presence of saponin compounds.

Determination of Water Content (Wandira et al., 2023)

The determination of water content is done by placing an empty porcelain cup in an oven at 105 °C for 1 hour. Then, the porcelain cup is cooled in a desiccator. After that, the empty cup is weighed. A total of 2 grams of sample was placed in a porcelain cup and placed in an oven at 105 °C for 3 hours.

Then, it was cooled in a desiccator and weighed again. The treatment was carried out until the weight of the cup containing the sample was constant at the time of weighing.

Cream Making

Weighing the ingredients is the first step in the process. Ingredients that are classified as oil phase (Phase I), namely vaseline album, mineral oil (paraffin liquidum), isopropyl myristate, stearic acid, glycerol monostearate, Nipasol are mixed and heated at a temperature of 70°C. On the other hand, the water-soluble ingredients (Phase II), namely Triethanolamine (TEA), Xanthan gum, and nipagin, are mixed into distilled water and heated to 70°C. The water phase is then added little by little to the oil phase and the mixing process is carried out in a hot mortar. Once the cream base is formed, extract is added bractea *Bougainvillea spectabilis* Willd., then stirred until homogeneous.

Table 1. Cream formulation (Iswindari, 2014)

Phase	**Material**	**Amount (%w/w)**		
		Formula 1	**Formula 2**	**Formula 3**
	Extract bractea *Bougainvillea spectabilis* Willd.	0,5	1,0	1,5
I	Oil phase			
	Vaseline album	6,2	6,2	6,2
	Mineral oil	13,8	13,8	13,8
	Isopropyl myristate	1,5	1,5	1,5
	Stearic Acid	7,5	7,5	7,5
	Glycerol monostearate	5	5	5
	Nipasol	0,05	0,05	0,05
II	Water phase			
	TEA	0,2	0,2	0,2
	Xanthan gum	0,2	0,2	0,2
	Nipagin	0,1	0,1	0,1
	Aquadest	100	100	100

Evaluation of Cream Preparations (Voight, 1994)

Evaluations carried out to check the quality of cream preparations include: organoleptic tests, pH tests, homogeneity tests, viscosity tests and physical stability tests.

a. Organoleptic

Testing uses the five senses.

Includes smell, appearance and color.

b. Homogeneity

A small amount of cream is smeared on a glass slide and the arrangement of the particles formed or any inhomogeneity is observed. The cream should show a homogeneous composition and no visible spots.

c. Use pH

Done using a pH meter. The pH meter is calibrated using a buffer solution. Measurements were carried out at a temperature of 25°C by dipping the pH meter electrode which had been rinsed with distilled water into the sample. The pH value is determined after the number read on the pH meter is stable. The pH tolerance range for cream preparations ranges from 4.0-7.5.

d. Viscosity

Using a viscometer *Brookfield*, by installing spindle no. 4 on the tool. Then, dipped into the preparation to a certain extent and a speed of 30 rpm at a temperature of 25°C. Each measurement is read on a scale (*dial reading*) when the red needle has stabilized. The viscosity value in centipoise (cps) is obtained from the multiplication results *dial reading* with a correction factor for each spindle. Good viscosity requirements for semi-solid preparations are 4000 – 40000cps.

e. Spreadability test

The spreadability of the cream was measured by placing it in the middle of transparent plastic covered with millimeter-sized blocks of paper. Then the diameter is measured for one minute. The experiment was repeated by adding loads weighing 50, 100, and 150 grams. Calculation of spreading power by calculating the diameter of the spreading surface. The requirement for excellent spreadability in cream preparations is 5-7 cm.

f. Test adhesion

Weigh 0.5 grams of cream, spread it on a glass plate, and weigh 500 grams for 5 minutes. Lift the load, release the two attached glass plates, and record the time until the two plates separate from each other.

g. Physical stability test

Cream preparations are stored at cold temperatures (4°C) and hot temperatures (40°C). and the stability parameters were measured, namely odor, color, pH, and viscosity, in the last sixth cycle.

Antioxidant Activity Test with the DPPH Free Radical Reduction Method (Simatupang et al., 2021)

The DPPH compound is used to calculate the IC50, or the concentration of antioxidants that inhibit 50% of free radicals, in order to determine the antioxidant activity of the ethanol extract Bractea *Bougainvillea spectabilis* Willd.

a. Preparation of 100 ppm DPPH solution

2 mg of DPPH was weighed and then dissolved in a 50 mL volumetric flask with pro-analytical ethanol in a 50.0 mL volumetric flask, until a 100 ppm DPPH solution was obtained.

b. Preparation of blank solution

Pipet 1 mL of 100 ppm DPPH solution into a 5 mL volumetric flask, add ethanol to 5 mL. Homogenized in a dark container.

c. Preparation of test solutions (extracts and cream preparations)

Test solutions were made with concentrations of 50 ppm, 75 ppm, 100 ppm, 125 ppm, 150 ppm.

d. Preparation of vitamin C control solution

The control solution was made by carefully weighing 100 mg of vitamin C, dissolving it in 100 mL of proanalysis ethanol with a concentration of 1000 ppm. Concentration series were made at 2.5 ppm, 5 ppm, 7.5 ppm, 10 ppm and 12.5 ppm respectively.

e. Testing of DPPH free radical scavenging activity

In each measuring flask, 2 mL of the preparation solution and 2 mL of DPPH solution and 1 mL of ethanol were added and then homogenized. After homogenization, it was incubated at 37°C for 30 minutes. The absorption of the solution was measured at the maximum wavelength using a UV-Vis spectrophotometer with a wavelength of 515 nm.

f. Calculation of DPPH free radical scavenging activity

The concentration of the test solution to reduce 50% of the anti-free radical activity is determined by the IC50 value, which is calculated based on the percent reduction of free radicals in the test solution using the equation obtained from the linear regression curve. The equation for calculating free radicals can be found below.

$$\% \text{ inhibition} = \frac{blanco\ \ absorbance - absorbance\ of\ the\ solution}{blanco\ absorbance} \text{x } 100\%$$

Table 2. EE x I values at wavelengths of 290-320 nm

Long wave	EE x I
290	0,0150
295	0,0817
300	0,2874
305	0,3278
310	0,1864
315	0,0839
320	0,0180
Total	1,0000

The absorption value obtained is multiplied by the EE x I value for each wavelength found in Table 2. The results of the product of absorption and EE x I are added up. The sum result is then multiplied by a correction factor whose value is 10; a value of 0% means that it has no anti-free radical activity, while a value of 100% means total reduction, and the test needs to be continued by diluting the test material to see the activity concentration limit.

Test Sun Protection Factor (SPF) (Cahyani et al., 2021)

A total of 0.1 grams of each ethanol extract cream, Bractea *Bougainvillea spectabilis* Willd. (F1, F2, and F3), was dissolved in 25 mL of 96% ethanol and mixed until homogeneous. Determining the effectiveness of sunscreen is done by determining the SPF value in vitro using a UV-Vis spectrophotometer. Ethanol extract cream (Bractea *Bougainvillea spectabilis*) will be diluted to 4000 ppm. Previously, the spectrophotometer was calibrated using 96% ethanol. Then, a test absorption curve was made in a cuvette with a wavelength of 290–320 nm and an interval of 5 nm, using 96% ethanol as a blank. Then, the absorbance results are recorded, and the SPF value is calculated (Yulianti *et al.*, 2015). We calculate the SPF value using the following formula:

SPF=CF x $\sum_{320}^{290} EE$ (λ) x I (λ) x Absorbance (λ)(4)
Information:
EE = Spectrum of erythema effects
I = Light intensity spectrum
Abs = Absorbance to get the SPF value of the preparation.
CF = Correction factor

Data analysis

Data analysis was carried out by calculating the percent (%) of antioxidant activity obtained from the absorbance data and then calculating the IC50 values by using a regression equation which states the relationship between extract concentration (x) and percent (%) antioxidant activity (y). Samples that have an IC_{50} values the lowest indicates that the sample has high antioxidant capacity (Jun *et al.*, 2003).

Results & Discussion

Simplicia

This research used an ethanol extract of Bractea *Bougainvillea spectabilis* Willd as the sample. A total of 4 kg of ethanol extract from Bractea *Bougainvillea spectabilis* Willd produces 960 g of fine simplicia

powder. Next, the water content is measured. The process of determining the water content aims to ascertain the water content in the simplicia. This is because a higher water content in the simplicia facilitates the growth of mold and mildew, which can lead to the simplicia's inability to withstand long-term storage and potentially reduce the activity of the active compounds within it. Bractea *Bougainvillea spectabilis* Willd should have a water content of approximately 10%. The results of determining the water content in this study were 5.5%, indicating that the water content in the simplicia met the requirements for water content in the simplicia.

Results of Extract Making

The maceration method extracted 265 grams of simplicia powder. This method was chosen because it is the easiest and simplest, does not require special equipment, and the temperature used is low so that it can prevent the decomposition of compounds that are not heat-resistant. Ethanol was chosen as a solvent because ethanol is polar, so it can attract polar compounds such as flavonoids, saponins, tannins, and others. 5 liters of liquid extract were obtained. After concentrating with an extract rotary vacuum evaporator at a temperature of 50°C, a thick extract of 95.00 grams of brownish-yellow color with a distinctive smell was obtained. The yield obtained was 35.85%. This extraction uses the maceration method because this method is one of the most common in the process of extracting natural ingredients. Apart from that, the maceration method is also selected because it is simpler, does not require special equipment, and is easy (Perawati *et al.*, 2022). 70% ethanol is used as a liquid filter because it can dissolve almost all substances, both polar, semipolar, and non-polar, such as flavonoids, tannin alkaloids, and saponins (Sentat & Permatasari, 2015). Stirring carries out this maceration process. The goal is to achieve homogeneous conditions.

Phytochemical Test Results of 96% Ethanol Extract Bractea Bougainvillea spectabilis Willd.

Phytochemical testing in this research aims to determine the compounds contained in extract. Phytochemical test results on ethanol extract 96% ethanol extract *Bougainvillea spectabilis* Willd showed positive results for alkaloids, flavonoids, steroids, polyphenols, quinones, saponins and terpenoids.

Table 3. Phytochemical Screening Results of 96% Ethanol Extract *Bractea Bougainvillea spectabilis*

Compound group	Observation
Alkaloid	+
Flavonoid	+
Steroid	+
Polyphenol	+
Quinones	+
Saponin	+
Tannin	-
Terpenoids	+

Information :
(+): Positive, contains active substances
(-) : Negative, does not contain active substances

Table 4. Simplicia Water Content Test Results *Bractea Bougainvillea spectabilis* Willd.

Drying Method	Moisture content (%)
Oven	5,500 ± 0,057

The water content determined to maintain the quality of simplicia is ≤ 10%, the resulting water content of 5.5% ≤ 10% meets the specified requirements.

Cream Making

Weighing the ingredients is the first step in the process. Water-soluble ingredients (Phase II) such as TEA, Xanthan gum, and Nipagin are mixed into distilled water heated to 70 °C. On the other hand, materials belonging to the oil phase (Phase I), such as vaseline album, mineral oil/paraffin liquidum,

isopropyl myristate, stearic acid, glycerol monostearate, and nipasol, are mixed and heated at the same temperature of 70°C.

The water phase is then added little by little to the oil phase, and the mixing process is carried out in a hot mortar. Once a cream base forms, add the ethanol extract (Bractea *Bougainvillea spectabilis* Willd) and stir until homogeneous.

The formulation of the cream preparation from this research is an O/W type cream preparation, due to its superior spreading power compared to other O/W types. Stearic acid and triethanolamine emulgators combine to form the cream. Triethanolamine and stearic acid combine to form triethanolamine stearate, a salt that stabilizes the type of cream oil in O/W water.

Results of Physical Evaluation of Cream Preparations

a. Organoleptic examination

Organoleptic examination of cream includes examination of color, aroma and texture.

Table 5. Organoleptic Examination Results

Preparation	**Before stability**		
	Color	**Texture**	**Smell**
Ethanol extract cream 0,5% (F1)	Brownish yellow	Semi-solid	Aromatic special
Ethanol extract cream 1.0% (F2)	Brownish yellow	Semi-solid	Aromatic special
Ethanol extract cream 1.5% (F3)	Brownish yellow	Semi-solid	Aromatic special
Cream base White	White	Semi-solid	Odorless
Vitamin C cream 0.5%	White	Semi-solid	Special smell
PABA Cream 2%	White	Semi-solid	Special smell

The addition of the Bractea *Bougainvillea spectabilis* Willd. extract causes the preparation to turn brownish yellow. This was proven before adding the ethanol extract. The base color of the Bractea *Bougainvillea spectabilis* Willd. cream is white. The aroma produced by the extract cream, Bractea *Bougainvillea spectabilis* Willd., depends on the concentration of the extract added to the cream preparation. The higher the extract concentration, the greater the resulting aroma.

Formula 3, which contains the highest concentration of Bractea *Bougainvillea spectabilis* Willd. compared to formulas 1 and 2, has the strongest aroma.

b. Homogeneity

Table 6. Cream homogeneity

Preparation	**Examination results**
Ethanol extract cream 0,5% (F1)	Homogeneous
Ethanol extract cream 1.0% (F2)	Homogeneous
Ethanol extract cream 1.5% (F3)	Homogeneous
Cream base White	Homogeneous
Vitamin C cream 0.5%	Homogeneous
PABA Cream 2%	Homogeneous

The homogeneity examination revealed that the preparations F1, F2, and F3, along with the cream base and positive controls, were homogenous. Para-amino benzoic acid (PABA) 2% and vitamin C 0.5% were homogeneous. If the cream exhibits an even texture and lacks lumps, it is considered homogeneous.

c. Cream pH results

Ethanol extract *bractea Bougainvillea spectabilis* Willd. has a pH of 6.7-6.9, meeting the pH value of sunscreen cream preparations ranging from 4.5-8.5 (SNI, 1996; Singh *et al*., 2011), compared to the positive control vitamin C which has a pH of 6.8 and PABA pH 5.6. If the pH of the cream is too alkaline it will cause scaly skin, whereas if it is too acidic it will cause skin irritation.

The results of the pH test can be seen in Table 7.

Table 7. Cream pH Test

Preparation	Examination results
Ethanol extract cream 0,5% (F1)	6,7 ± 0,0
Ethanol extract cream 1.0% (F2)	6,8 ± 0,1
Ethanol extract cream 1.5% (F3)	6,9 ± 0,1
Cream base White	6,7 ± 0,1
Vitamin C cream 0.5%	6,8 ± 0,1
PABA Cream 2%	5,6 ± 0,2

d. Adhesion test

Table 8. Adhesion test

Preparation	Examination results
Ethanol extract cream 0,5% (F1)	2,74 ± 0,28
Ethanol extract cream 1.0% (F2)	2,85 ± 0,00
Ethanol extract cream 1.5% (F3)	3,43 ± 0,15
Cream base White	2,91 ± 0,03
Vitamin C cream 0.5%	2,94 ± 0,16
PABA Cream 2%	3,31 ± 0,25

Testing adhesive power F1 (2.74 seconds), F2 (2.85 seconds), F3 (3.43 seconds), cream base (2.91 seconds), vitamin C 0.5% (2.94 seconds), and PABA 2% (3.31 seconds). These results indicate that formula 3, with an extract concentration of 1.5%, exhibits a longer adhesion than F1, F2, the basis, the positive control, vitamin C, and PABA. However, these three preparations still meet the requirements for a good adhesion range, making them suitable for skin application.
The adhesive test aims to determine the time it takes for the cream to stick to the skin. Good adhesion means that the cream does not come off easily and sticks to the skin longer, so it can produce the desired effect.

According to Roosevelt *et al.* (2019), the requirements for good cream adhesion range from 2–3000 seconds, based on related research. If the adhesion test results do not meet the specified range of requirements, this can affect the release of the active substance when applied to the skin. The higher the concentration of stearic acid and triethnolamine, the stronger the adhesive.

The research assumes a relationship between the viscosity value and the adhesion test of the *Bougainvillea spectabilis* Willd bractea extract cream preparation, where a higher viscosity value results in a longer time for the cream to adhere.

e. Viscosity

The viscosity test results can be seen in Table 9

Table 9. Cream viscosity test

Preparation	Examination results
Ethanol extract cream 0,5% (F1)	2574,13 ± 0,28
Ethanol extract cream 1.0% (F2)	2922,30 ± 0,00
Ethanol extract cream 1.5% (F3)	3267,57 ± 0,15
Cream base White	3230,40 ± 0,03
Vitamin C cream 0.5%	2925,57 ± 0,16
PABA Cream 2%	2155,40 ± 0,25

The viscosity test showed F1 (2574.13 Cp), F2 (2922.30 Cp), F3 (3267.57 Cp), cream base (3230.40 Cp), vitamin C cream (2925.57 Cp), and PABA cream (2155.40 Cp). According to research, the F3 value has the highest viscosity value when compared to F1, F2, cream base, positive control vitamin C cream, and PABA. However, based on the viscosity requirements, all cream preparations meet the requirements of a good viscosity range.

Viscosity testing is one of the requirements for testing cream preparations. Viscosity is a measure of a liquid's ability to flow; the higher the viscosity, the more difficult it is to flow, or the thicker the preparation. The viscosity test is carried out to determine the viscosity level of the product produced. According to SNI 16-4399-1996, there are good viscosity requirements of 2,000 cP–50,000 cP, according to related research. If the cream preparation has a high viscosity, it will be thicker. We

conducted this viscosity test using a Brookfield viscometer. The viscosity test assumes that the addition of the extract influences the viscosity of the cream preparation. The higher the extract, the thicker the cream preparation. Therefore, if the cream preparation is thicker, the cream's stickiness will increase.

f. Spreadability

Table 10. Screen Cream Spreadability Test Results

Preparation	Examination results
Ethanol extract cream 0,5% (F1)	11,53 ± 0,28
Ethanol extract cream 1.0% (F2)	10,60 ± 0,00
Ethanol extract cream 1.5% (F3)	10,47 ± 0,15
Cream base White	10,27 ± 0,03
Vitamin C cream 0.5%	10,50 ± 0,16
PABA Cream 2%	10,47 ± 0,25

Based on the spreading power test with a 500-gram load, F1 had the largest spreading diameter at 11.50 cm, followed by F2 at 10.60 cm, F3 at 10.47 cm, cream base at 10.27 cm, vitamin C 0.5% cream at 10.50 cm, and PABA 2% cream at 10.17 cm. F2 and F3 were also wider than F3, cream base, and the positive control (0.5% vitamin C cream and PABA 2%). The measurement results indicate that all cream preparations exhibit a good distribution diameter and are suitable for skin application. The spreadability test seeks to assess the softness of the cream mass, gauging its ease of application to the skin. The cream's spreadability can determine absorption at the application site, the greater the power.

The more spread, the more cream will absorb. High viscosity can influence low spreadability values. How much of the skin's surface area comes into contact with the cream preparation during application determines the spreadability of the cream.

g. Cream stability test

Table 11. Cream stability test

Preparation	Homogeneity test	pH test	Spreadability Test	Adhesion test	Viscosity test
Ethanol extract cream 0,5% (F1)	Homogeneous	6,7 ± 0,06	11,40 ± 0,00	2,71 ± 0,09	2569,97 ± 8,32
Ethanol extract cream 1.0% (F2)	Homogeneous	6,7 ± 0,00	10,50 ± 0,05	2,81 ± 0,29	2793,37 ± 67,10
Ethanol extract cream 1.5% (F3)	Homogeneous	6,9 ± 0,06	10,20 ± 0,03	3,43 ± 0,08	3209,87 ± 4,90
Cream base White	Homogeneous	6,7 ± 0,06	10,20 ± 0,00	2,90 ± 0,01	3199.20 ± 20,54
Vitamin C cream 0.5%	Homogeneous	6,8 ± 0,06	10,50 ± 0,10	2,94 ± 0,16	2924,40 ± 36,82
PABA Cream 2%	Homogeneous	5,4 ± 0,15	10,40 ± 0,05	3,30 ± 0,25	2080,47 ± 54,90

The stability test on 1.5% (Formula 3) ethanol extract cream has the highest stability compared to Formula 1, 2, with 0.5% vitamin C cream, and 2% PABA cream.

Significance test: The results of the t test on pH before and after the cream stability test show that the significance value is 0.203 > 0.05, meaning the preparation is stable. The t test results on adhesion also show that the significance value before and after the stability test is 0.08 > 0.05, which means the dosage is stable. Before and after the stability test, the t test on viscosity shows that the significance value is 0.054 > 0.050, meaning the dosage is stable, and the t test on spreadability shows that the significance value is 0.053 > 0.050, meaning the dosage is stable.

Antioxidant Test Results for 96% Ethanol Extract Cream Bractea Bougainvillea spectabilis leaves Willd

Table 12. Antioxidant Test Results

Preparation	IC_{50} values ± standard deviation	category
Ethanol extract cream 0,5% (F1)	26,62 ± 6,73	Very strong
Ethanol extract cream 1.0% (F2)	26,15 ± 3,22	Very strong
Ethanol extract cream 1.5% (F3)	10,48 ± 3,92	Very strong
Vitamin C cream 0.5%	2,18 ± 0,84	Very strong

IC_{50} < 50 mg/mL is a very strong category, a value of 50-100 mg/mL is a strong category, a value of 100-150 mg/mL is a moderate category, 150-200 mg/mL is a weak category, > 200 mg/mL is a very weak category. Formula F3 has higher antioxidants than F2 and F1, the smaller the IC_{50} values this means the antioxidant activity is higher.

Test result Sun Protection Factor

Value measurement *SPF* using a Shimadzu UV mini-1700 V UV-Vis spectrophotometer with a wavelength range of 290-320 nm. A sample of 100 mg was dissolved in 25 ml of 96% ethanol, mixed until homogeneous. Then the absorption is measured. Previously the UV-Vis spectrophotometer was calibrated using 96% ethanol. The SPF value test results can be seen in Table 13.

Table 13. SPF Value Test Results

Preparation	SPF values ± standard deviation	Category
Ethanol extract cream 0,5% (F1)	12,48± 0,05	Minimal protection
Ethanol extract cream 1.0% (F2)	16,69 ± 0,21	Ultra protection
Ethanol extract cream 1.5% (F3)	21,22 ± 1,58	Ultra protection
Vitamin C cream 0.5%	6,95 ± 0,51	Extra protection

An SPF value of 1-4 indicates a minimum protection category; a value of 4-6 indicates a medium protection category; 6–8 indicates an extra protection category; 8–15 indicates a maximum protection category; >15 indicates ultra protection. Formula F3 has a higher SPF than formulas F2 and F1, and the positive control is 2% PABA cream. The higher the SPF value, the greater the sunscreen activity. Ethanol extract from Bractea *Bougainvillea spectabilis* Willd has one of the most important ingredients, namely flavonoids and alkaloids, which act as antioxidants and are useful as active ingredients in sunscreen. The research results revealed relationships between antioxidant activity and SPF values. The higher the antioxidant activity, the higher the cream's SPF value. The results of the research carried out were in accordance with the research variables and in line with previous research on Bougainville Flower (*Bougainvillae spectabilis* Willd) Extract (In Vitro) Activity Test as Sunscreen, The ethanolic extract of *Bougainvillae spectabilis* Willd has SPF values at concentrations of 200, 400, 600, and 800ppm, respectively, which are 2,583, 7,612, 20,715 and 64,367 (Yuliani *et al*, 2024), then made into a cream preparation and tested again for antioxidant and sunscreen activity. The contribution of this research is as an alternative to cosmetic preparations in the form of natural creams which are effective as antioxidants and sunscreen to prevent exposure to UV radiation from the sun which causes sunburn, eritema/irritation, edema, pigmentation and skin cancer.

Conclusion

Based on the results it can be concluded as, 96% ethanol extract *bractea Bougainvillea spectabilis* Willd can be made into antioxidant cream and sunscreen with good physical quality. Antioxidant activity of 96% ethanol extract *bractea Bougainvillea spectabilis* Willd., Formula F3 has IC_{50} 10,48 ± 3,92 (very strong category) has higher antioxidants than F1 has IC_{50} 26,62 ± 6,73 (very strong category) and F2 has IC_{50} 26.15 ± 3.22 (very strong category). Formula F3 had lower antioxidant activity than the positive control, 0.5% vitamin C cream had IC_{50} 6.95 ± 0.51 (very strong category). Sunscreen activity of 96% ethanol extract *bractea Bougainvillea spectabilis* Willd. F3 has an SPF value of 21.22 ± 1.58 (ultra protection category) and has higher sunscreen activity than F1 with an SPF value of 12.48 ± 0.05 (minimal protection category) and F2 with an SPF value of 16.69 ±

0.21 (ultra protection category) and positive control PABA2% cream SPF value 6.95 ± 0.51 (extra protection category).

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Conflict of Interest

Authors declare no conflict of interests.

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